CRITICAL SUCCESS FACTORS AFFECTING TECHNOLOGY TRANSFER EFFECTIVENESS: A STUDY ON ELECTRIC AND ELECTRONIC COMPANIES IN MANUFACTURING INDUSTRY IN MALAYSIA.

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ABSTRACT

Critical success factors are critical factors or activities required for ensuring the success of your business. The term was initially used in the world of data analysis, and business analysis. Critical success factors have been used significantly to present or identify a few key factors that organizations should focus on to be successful. The key to using CSFs effectively is to ensure that organizations definition of a factor of their organizations activity which is central to its future will always apply. Therefore success in determining the CSFs for organizations is to determine what is central to its future and achievement of that future. Some researcher also indicated that identifying CSF's is important as it allows firms to focus their efforts on building their capabilities to meet the CSF's, or even allow firms to decide if they have the capability to build the requirements necessary to meet Critical Success Factors (CSF's). Furthermore, in any organization certain factors will be critical to the success of that organization, in the sense that, if objectives associated with the factors are not achieved, the organization will fail and perhaps trouble so. There are four basic types of CSF's, there are: Industry CSF's resulting from specific industry characteristics; Strategy CSF's resulting from the chosen competitive strategy of the business; Environmental CSF's resulting from economic or technological changes; and Temporal CSF's resulting from internal organizational needs and changes. Each CSF should be measured and associated with a target goal. Not exact measures to manage are needed. Primary measures that should be listed include critical success levels (such as number of transactions per month) or, in cases where specific measurements are more difficult, general goals should be specified (such as moving up in an industry customer service survey). Not only that, CSF's are tailored to a firm's or manager's particular situation as different situations (e.g. industry, division, individual) lead to different critical success factors. There are five key sources of CSF's which are: the industry, competitive strategy and industry position, environmental factors, temporal factors, and managerial position (if considered from an individual's point of view).We will carry out hypothesis testing using SPSS. Sample for this study will be selected from directory of Federal Manufacturing of Malaysia (FMM). This study will give significant impact toward manufacturer in implementing technology transfer process.

Keywords: Critical success factor; Technology transfer; Effectiveness; Manufacturing

INTRODUCTION

Technology transfer or new technology implementation refers to the process of transferring science and technology from one individual or group to another that joint together this new technology into a new or improved process, product, system or way of doing something. Nevertheless, Samli (1985) said that technology transfer has been a subject of considerable interest to many groups, such as government policymakers, international funding agencies, and business executives, because of the close relationship between technology transfer and economic growth. Additionally, technology transfer has aroused the interest of academic researchers not only from the developing countries but also from developed countries as it concerns of technology transfer and mechanisms of technology transfer remains vague, controversial, and inadequately operationalised.

Critical Success Factor

The need for the critical success factor is essential skills for an excellent carrier said in its website that, CSFs are the essential areas of activity that must be performed well if you are to achieve the mission, objectives or goals for your business or project. By identifying your Critical Success Factors, you can create a common point of reference to help you direct and measure the success of your business or project. As a common point of reference, CSFs help everyone in the team to know exactly what's most important. And this helps people perform their own work in the right context and so pull together towards the same overall aims. Inevitably, the CSF concept has evolved, and you may have seen it implemented in different ways. This article provides a simple definition and approach of CSFs as:

> *"Critical success factors are the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where things must go right for the business to flourish. If results in these areas are not adequate, the organization's efforts for the period will be less than desired."* He also concluded that CSFs are "*areas of activity that should receive constant and careful attention from management.*"

Critical Success Factors are strongly related to the mission and strategic goals of your business or project. Whereas the mission and goals focus on the aims and what is to be achieved, Critical Success Factors focus on the most important areas and get to the very heart of both what is to be achieved and how you will achieve it.

According to other researcher, every organization has a mission that describes why it exists (its purpose) and where it intends to go (its direction). The mission reflects the organization's unique values and vision. Achieving the mission takes the participation and skill of the entire organization. The goals and objectives of every staff member must be aimed toward the mission. However, achieving goals and objectives is not enough. The organization must perform well in key areas on a consistent basis to achieve the mission. These key areas can be defined as the organization’s critical success factors whereas unique to the organization and the industry in which it competes. The critical success factor method is a means for identifying these important elements of success. It was originally developed to align information technology planning with the strategic direction of an organization. However, in research and fieldwork undertaken by members of the Survivable Enterprise Management (SEM) team at the Software Engineering Institute, critical success factors has shown promise in helping organizations guide, direct, and prioritize their activities for developing security strategies and managing security across their enterprises.

Technology Transfer

According to Martyniuk *et* al. (2003), technology transfer or new technology implementation refers to the process of transferring science and technology from one individual or group to another that joint together this new technology into a new or improved process, product, system or way of doing something. Furthermore, Miles (1995) indicated that, technology transfer is recognized as the acquisition, adaptation and use of technological knowledge by an individual, group, or society and the one that develop the technology. Nevertheless, Samli (1985) said that technology transfer has been a subject of considerable interest to many groups, such as government

policymakers, international funding agencies, and business executives, because of the close relationship between technology transfer and economic growth. Additionally, technology transfer has aroused the interest of academic researchers not only from the developing countries but also from developed countries as it concerns of technology transfer and mechanisms of technology transfer remains vague, controversial, and inadequately operationalised. Technology transfer is shrouded not only in controversy and emotion, but also in considerable confusion, owing to the complexity of "technology" itself and the multiplicity of channels of its "transfer".

Additonnally, IPCC Working Group III (2000) illustrated that, technology transfer in particular from developed countries to developing countries, must therefore operate on a broad front covering these software and hardware challenges, and ideally within a framework of helping to find new sustainable paths for economies as a whole. Furthermore, technology transfer results from actions taken by various stakeholders. Key stakeholders include developers; owners; suppliers, buyers, recipients and users of technology (such as private firms, state enterprises, and individual consumers); financiers and donors; governments; international institutions; NGOs and community groups. Other than that, some technology is transferred directly between government agencies or wholly within vertically integrated firms, but increasingly technology flows depend also on the coordination of multiple organizations such as networks of information service providers, business consultants and financial firms. Although stakeholders play different roles, there is a need for partnerships among stakeholders to create successful transfers. Governments can facilitate such partnerships. While technology transfer processes can be complex and intertwined, certain stages can be identified. These may include the identification of needs, choice of technology, assessment of conditions of transfer, agreement and implementation. Evaluation and adjustment to local conditions, and replication are other important stages. Developing country governments can build local capacities to gear them for technology transfer. Training and human resource development have been popular development assistance activities. Future approaches can be more effective by better stressing the integration of a total package of technology transfer, focusing less exclusively on developing technical skills and more on creating improved and accessible competence in associated services, organizational know-how, and regulatory management. Because of that, also said that there are many factors which importantly affect and are affected by various transfers such as national development plans, education, labor, investment and trade policies, the political and economic context, and policies of and relations with suppliers. It is therefore necessary to examine the effects of technology transfer in the particular productive enterprise. According to Sabourin *et* al., (1999), technology use also varies across industries such as in beverages, primary textiles, paper and allied products, primary metals, and electrical and electronic products tend to have the highest adoption rates.

Technology Transfer In Malaysia

Shiowattana *et* al., (1991) said that past studies view that technology transfer by MNCs to developing countries as a dynamic and on-going process. Regarding to Lai *et* al., (1997), the current issues on technology transfer in Malaysia industries no longer taking about MNCs are transferring their technology to the Malaysian industries but the issues that focus most is on the effectiveness, efficiency and success of implementation of technology transfer. On the other hand, Raduan *et* al., (2002, 1991) illustrated that MNCs contend that the transferring process is mainly disturbed by low maturity of the Malaysian industry which is largely due to not enough of personnel skill and weak institutional support and business environment. As illustrated by Davenport *et* al.,

(1998, 2000), from the recipient's perspective, technology transfer success also includes the ability to learn, acquire, absorb and apply new external technologies and knowledge embedded in product materials, physical assets, processes and production, and management capabilities not only possessing the ability to operate, maintain or repair the machineries at the production level (transmission).

Manufacturing Sector

Globalisation has increasing the level of competition in the international market. The fast-changing global industrial environment is pushing companies to improve their competitiveness by acquiring new technical skills and investing in more advanced technologies. This is reflected in the national development agendas, which is implemented in the Ninth Malaysia Plan, in which the key strategies for manufacturing sector are continued from 2006 to 2010 periods respectively. In order to enhance national long term competitiveness, the government will continue to promote the transition to higher value-added activities in three main economic sectors, the first being manufacturing; second, services; and third, agriculture. The manufacturing sector is projected to expand by 6.7 percent per annum, and will continue to shift to high-technology and knowledge-intensive activities with high value-added content in various industries, especially involving electrical and electronics, petrochemicals, biotechnology, machinery and equipment, aerospace and maritime. Furthermore, manufacturing efforts will continue to focus on increasing the use of technology and developing a strong domestic base in terms of capabilities and knowledge.

Manufacturing Companies

However, there are many factors inhibiting the adoption of new technologies, particularly by manufacturing companies. According to Saha, (1998), manufacturing companies must have the ability to develop a new technology rapidly, and effectively transfer this technology to the manufacturing fabrication facility because a typical product life cycle is three to five years, and a new technology emerges in every three years. Unfortunately, he also said that when a new process technology is transferred into high-volume manufacturing, the performance objectives of the process-specific designs shift in high-volume manufacturing equipment. The government will prepare specific incentives to attract investments, including high quality FDI for manufacturing sector activities that are being promoted. Therefore, any changes in designs must be compensated in the manufacturing fabrication for rapid introduction of competitive new products in the market place. The government will continue to emphasize on the policy to increase the production of capital and intermediate goods to provide a range of economic benefits such as improvements in the balance of payments and foreign reserves. Nevertheless, Grant *et* al., (1997), conclude that the extent of transfer of tacit knowledge often has a major impact on the effectiveness of manufacturing technology transfer according to case studies of manufacturing technology transfer and the role of tacit knowledge that there analyzed.

Technology Transfer Effectiveness

Providing the technology transfer to foreign country or firms is not easy; we have to understand the process of technology transfer itself. Not only that, we also have to know the way to make the technology that have been transferred, success and effective. As we know, Malaysia acquiring many new technology from the foreign country. When acquiring technology, a key concern is, to really catch up and increase technological capability. Therefore acquired technology must be successfully utilized in operations to produce a product or service and thus links to technology transfer effectiveness. According to Wong *et* al., (1999) The effectiveness of a technology transfer can be

defined as the objectives of a specific technology transfer project. In order to adjust the new technology to a continually changing business environment, Whangthomkum *et* al., (2006) said that firms must make efforts to effectively integrate it with existing technology to create either a new product or process. According to Spann *et* al., (1995), technology transfer used different outputs, and different effectiveness measures based on the specific objectives, goals, mission, and roles of the technology transfer projects. As a conclusion, Tektas *et* al., (2008) illustrate that effective technology transfers provides success to the companies.

The purpose of this study is to measure effectiveness of technology transfer to generate critical success factors from the factors of market impacts, economic, regulation and reimbursement policies, and managerial. Each factor will evaluate by comparing them with moderating factor called organizational factors to see the relationship between them, whether positive or negative relationships toward technology transfer effectiveness which is to improve productivity and to decrease cost. Under the analysis of this study, it may further provide understanding of critical success factors and sub-factors toward effectiveness of technology transfer in Malaysia's manufacturing industry.

Since new technology is developing at an amazing rate in countries across the world, technology transfer becomes a highly complex issue in developing countries and regions. Researchers and practitioners around the world have realized the important of technology transfer effectiveness. Many people believe that technology transfer is one of the critical elements in the global operations of international company.

Some of the problems face introducing critical success factor are many according to few researcher, which indicated some of the problems are as follows.

Market Impacts

The market impacts evaluate technology transfer effectiveness according to the commercial success of the transferred technology or information. Generally, market impacts interfere to a single firm or just a few firms. Furthermore, World Trade Organization (WTO) clarify that one of the major problems to technology transfer is market distortions and weak. But a lot of technology transfer, especially that ensure by universities and government agencies, is rationalized by broader economic multipliers assumed to flow from technology transfer (Bozeman, 2000). According to Tenkasi R. V. and Mohrman S. A. (1994), the process of transferring and adopting the technology became extremely difficult when transferred products were very antithetical to what the manufacturing and/or marketing groups defined as product requirements. Jain (2007) illustrated that there are other issues that related to marketing, all of this issues such as people (perceptions, risk aversion), process (implementation requirements, adoptability and adaptability), incentives, disincentives, regulations and organization policies all could foster or adversely affect the use of new technology. Not only that, from the marketing point of view, Chang *et* al., (2002) said that, role in defining product specification for applications is limited in Taiwan by its small scale of the domestic market, and its competitiveness originates from the design speed, quality, cost and flexibility. According to Azzone *et* al., (1997), based on their study of technology transfer in the biomedical industry, they suggest that the critical mass of demands for technologies and technical competencies is a major factor in determining market impact technology transfer success. Furthermore, Gander (1986) also said that clear strategic implications for technology transfer effectiveness is the question of market-"puch" or –

"pull". Nevertheless, Cannice *et* al., (2003, 2001, 2004) illustrated that, the technologies that have already diffused to the industry and the market are called mature technologies.

Technology Transfer

Besides**,** technology transfers also facing various problems in transferring the technology. This statement is supported by several researchers. According to Azmawani (2008), he said that Sako (1992) have been highlighted that technology transfer and training is one of the three major areas where supplier relationships may not be strictly arm's length, but may require some moderate to extreme extensions from the traditional arm's length relationships. Referring to technology transfer as the movement of technology from one organisation to another, which is across the organisational boundaries of the source and recipient. Stock *et* al., (2000) observed that even when the technology is functional in its present form and less complex, due to the lack of expertise or experience, the recipient may not know how to utilise it immediately. Both Saleh *et* al. (2001) and Swanson (1997) indicated how the technology supplier can add value to the overall success of technology implementation. In this respect, a well established, close relationship may make inter-firm boundaries more permeable, allowing technology to be transferred more easily into the organisation (Heide *et* al., 1990).

Effectiveness

Unfortunately, according to Bozeman (2000), many studies of technology transfer never make clear about the meaning of effectiveness and seem simply to assume that the unitary concept of effectiveness is hold some unspecified. As the following discussion shows by Ostrower, F., (2004), so many cases is needed for foundations (foundation leaders) to explain specific understanding of effectiveness to their own institutions, to remain attentive to these, and to assess themselves in relation to the effectiveness approach they have chosen by ensuring that they have a regular process in place. According to Ostrower, F., (2004), his study emphasizes that a bigger obstacle to achieving effectiveness and measuring progress toward it is that all too often foundations have not clarified the meaning of effectiveness. Additionally, he also said that absent a clear conception of effectiveness, foundations cannot assess (quantitatively or otherwise) whether or not they have achieved it, and risk adopting measures first and then adjusting their conceptions of success to fit the measures. Furthermore, he indicated that, foundations that are otherwise quite different, with respect to size and type, often face quite similar challenges when it comes to difficulties in defining and achieving effectiveness. The problem of defining and achieving effectiveness for foundations is deeply shaped by their unique insulation from external forces. According to Buckley (2007), effectiveness represents outcomes achieved from a treatment or health intervention in real, practical settings (e.g., the real world). Furthermore, Friman (2006) indicated that effectiveness is commonly described as a function of output which means that we need to define the system and have the ability to measure the output in order to observe output or results. Not only that, he also said that effectiveness should be considered as a relative term that gives the ability to achieve stated goals or objectives, judged in terms of both output and impact under certain conditions. According to UNDP (2001), improvement in the effectiveness of the projects is even more important under the new result-centered orientation of UNDP. Additionally, UNDP (2001) also said that effectiveness measures the extent to which a project or programme has achieved its objectives and results, independent of the costs that were required for it.

Technology Transfer Effectiveness

Other problems that occur in technology transfer effectiveness are lack of skills for the new business environment; heavy regulatory burden and procedures; lack of managerial skills; lack of skilled and talented workers, which affects the quality of production, efficiencies and productivity; limited capacity for technology management and knowledge acquisition; intensified global competition; price competition with other producers, such as Indonesia, China, Thailand and India; ability to meet the challenges of market liberalization and globalizations; non-compliant products to ISO quality standard; motivation to seek latest information and update the knowledge; lack of a comprehensive framework in term of policies towards manufacturing development; limited knowledge on capabilities of the current systems; lack of information on potential markets and customer (Burhanuddin *et* al., 2009). Furthermore, Bhardwaj *et* al., (2005) had highlighted that there are several problems that occur in technology transfer such as high cost of technology and organizational resistance consist of organizational culture, power structure and organizational structures.

Economic Factors

Technology transfer is a key element for economic development across all levels of industry, and is an important mechanism to foster economic growth and innovation intensity (Radosevic *et* al., (1999, 2005). It is seen as a valuable tool for helping developing countries to tackle economic crisis and pressure (Bell 1993).

Regulation & Reimbursement Policies

According to WTO (2002), a regulatory constraint was the major problems to technology transfers to developing countries like Malaysia. Technology transfer raise difficult choices for policy makers in recipient and supplier countries because it is impossible to anticipate all the future consequences or even trace the effects of past technology transfers.

Technology transfer policy can be classified according to the extent of government intervention in the economy and the preferred mode of technology transfer. Policy choices affecting technology transfer often reflect political compromises, foreign policy aims, and social values. Furthermore, Odle M. A., (1983) said that exporting obligations are becoming a major performance requirement for manufacturing concerns in some countries owing to serious balance of payments adjustment problems. Not only that, technology transfer also affected the country risk. Besides, Sushil (2007) said that elements in country risk that related to this study are difficulties in political approvals and the barriers due to legal regulations for technology transfer.

Organizational Factors

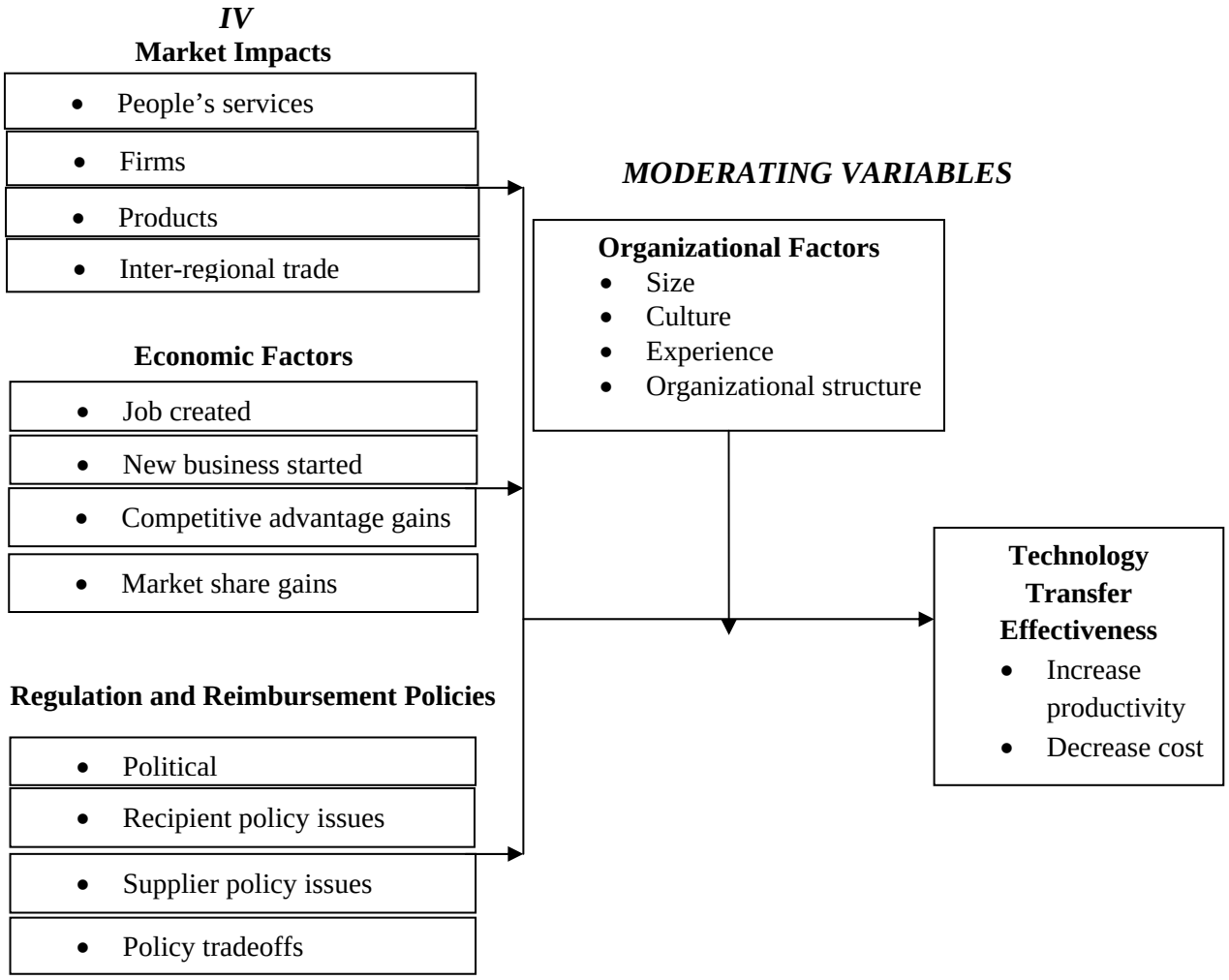
Organizations often fail because of poor management. With the increasing rate of technological breeding, the high obsolescence of technology, and increasing global competitiveness, the success or failure of any organization depends greatly on its ability to cope and adapt (Madu, 1992). The organization participates in technology transfer either reflexively or because there is a directive to do so, but there is not particular regard for the impacts of technology transfer. (Bozeman, 2000). As indicated by Sushil (2007) in the same journal that the organizational risks in technology transfer may be extremely because of the lack of organizational capabilities to absorb and implement the acquired technology. Additionally, researchers have shown that there are several problems occur in technology effectiveness. Some problems related to the characteristics of the practices that are being transferred and others of a cultural and

organizational nature (Ghoshal & Bartlett, 1988; Kedia & Bhagat, 1988; Szulanski, 1996; Zander & Kogut, 1995).

Increase Productivity & Decrease Cost

On the other hands, there are several problems that happen in productivity and cost. For examples, UNIDO said that the coats of setting up facilities could be relatively high; and operating them and doing business, such as sale, purchase, export and import, paying legal dues and dealing with various authorities (local, regional and national) could be cumbersome. There is the need to reduce these "transaction costs" in order to attract foreign investors who have a much wider option before them and are able to compare these transaction costs in different countries. In other cases, Spann *et* al., (1995) indicated that firm-level measures are related to internal performance issues: to achieve a specific return on investments made in technology development, to develop new products, to improve productivity, to decrease costs, to have satisfied technology users and to solve technical problems. According to Acemoglu, (2007), the economic debate has arrived at the consensus that differences in technology are a significant cause of differences in the performance and productivity of firms, sectors, and countries. Indeed, Brach *et* al., (2009) said that to be an extremely important source of productivity, innovations in the high-tech field and in leading international research have proven. Additionally, Arora *et* al., (2005, 1995, 2004, 1999, 2002) illustrate that, the focus of the productivity debate in the context of non-OECD countries has shifted, in essence, from the development of productivity-increasing technologies to their accessibility. Furthermore, Brach *et* al., (2009), for countries without or with only limited indigenous research activities, there is, according to the consensus, the comparably easy possibility of using the existing technologies on the global market as a source of productivity—especially through channels such as international trade and the revolutionized information and communications technologies. Nevertheless, Keller (2004) compares various channels of international technology transfer and points out that, despite extensive offers of foreign technology, local technological endeavors particularly increase the productivity of accessible technologies. Not only that, Barton, J. H., (2007) also said that the concerns were that the costs of the technology (many of which were hidden through transfer prices or management fees) were too high, that host nation use of the technology was often hindered by restrictive clauses, and that the licensees often failed to receive the best technology.

Theoretical Framework



DISCUSSION

Nevertheless, the success or failure of TT's effectiveness is difficult to evaluate due to its complex structure, which contains multiple dimensions from transferor and transferee, such as technology, culture, and people in organizations. An abundant research on TT has been discussed for years; however, many firms still suffer from the uncertainty of measuring the effectiveness of TT. (Lai *et* al., 2009).

All the above mentioned factors have been highlighted in previous technology transfer case studies, exploratory and empirical research. This study tries to confirm some of their initial findings and perhaps resolve some of the uncertainty. This study then presents the results of an empirical test on factors related to the technology itself that can enhance the effectiveness of technology transfer. Hopefully the results of this study could become a guide for firms involved in the technology transfer process. Study frame are as follows.

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